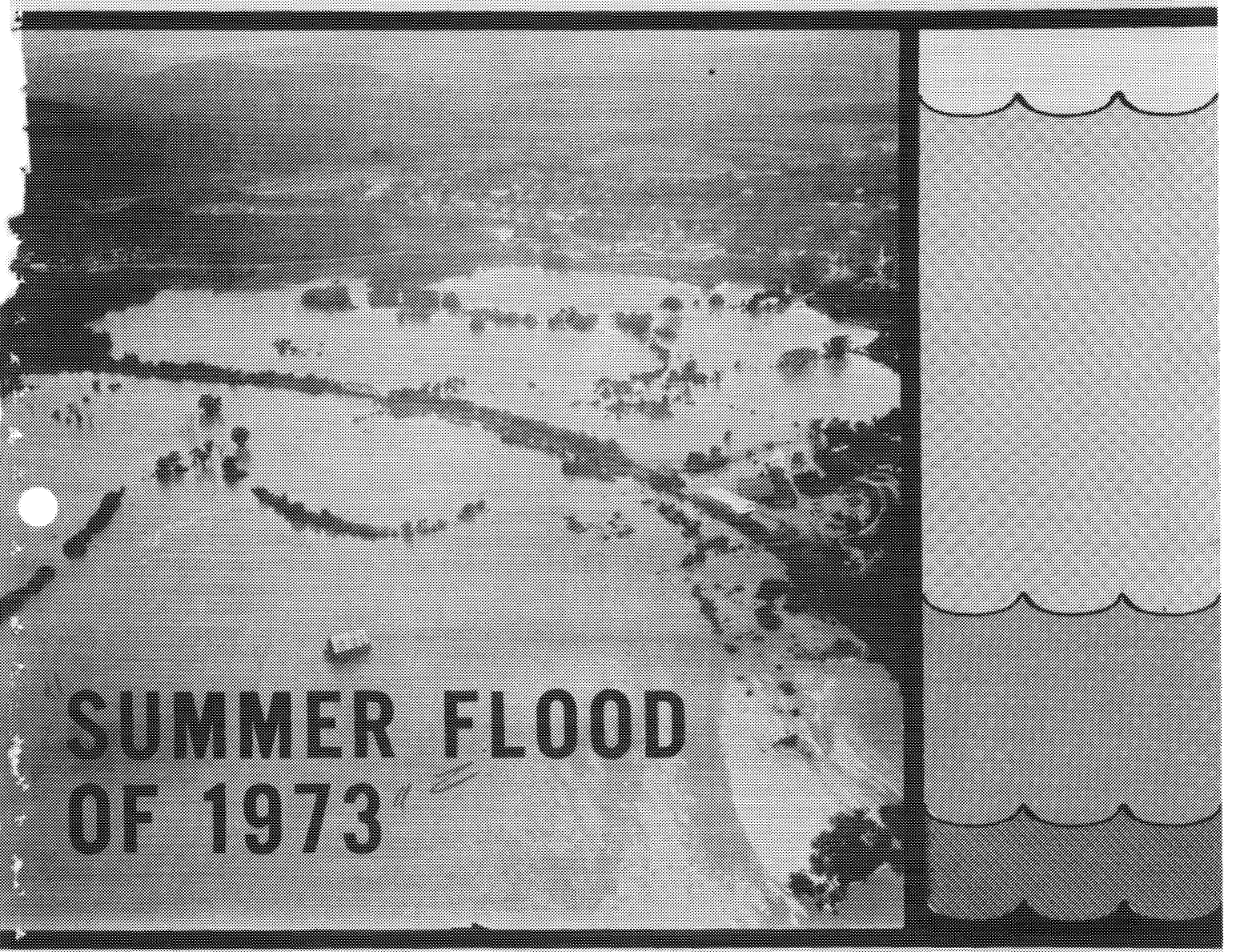
VERMONT
NEW HAMPSHIRE



SUMMER FLOOD OF 1973

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION
MARCH 1974

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SUMMARY OF ILLUSTRATIONS

I. THE FLOOD: 29 JUNE - 5 JULY 1973.

During the last four days of June 1973, a strong moist tropical airflow in association with a stationary frontal system resulted in moderate to heavy shower activity over much of the New England area. Rainfall amounts varied from about 2 inches in coastal regions to 7 inches in the western hills of Connecticut, to approximately 8-10 inches in the high mountains of Vermont and New Hampshire. At various times on the 29th and 30th the shower activity was torrential in nature with reported amounts of 4 inches in a 6-hour period. An isohyetal map for the storm period 27-30 June is shown on Plate 1. The following tabulation presents rainfall data at selected locations.

TABLE 1

TOTAL RAINFALL AT SELECTED STATIONS
27-30 JUNE 1973

Station	Total (inches)	Station	Total (inches)
VERMONT		CONNECTICUT	
Ball Mountain Lake	7.8	Thomaston Dam	7.7
South Londonderry	7.7	Hop Brook Lake	6.7
Wilmington	6.3	Hartford	3.1
North Springfield Lake	5.7		
Townshend Lake	5.7	MASSACHUSETTS	
North Hartford Lake	5.0		
Passumpsic	4.2	Knightville Dam	4.6
		Turners Falls	4.4
NEW HAMPSHIRE		Worcester	3.4
		Springfield	3.3
Mt. Washington	10.0	Boston	2.1
Rumney	8.3		
Franklin Falls Dam	5.1	RHODE ISLAND	
		Woonsocket	2.6

ISOHYETAL MAP (RAINFALL PATTERN) 27—30 JUNE 1973

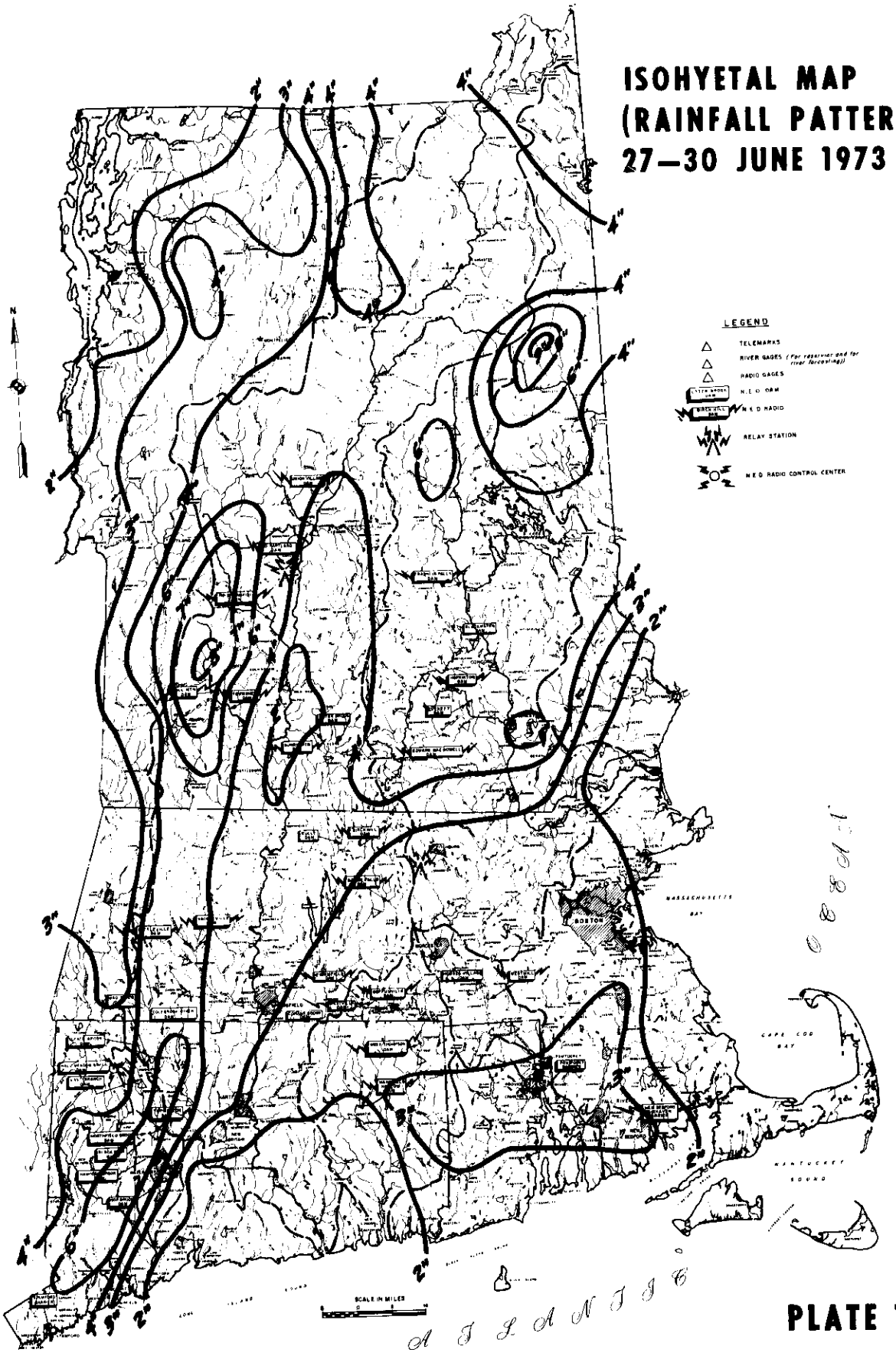


PLATE 1

A. FLOOD DISCHARGES.

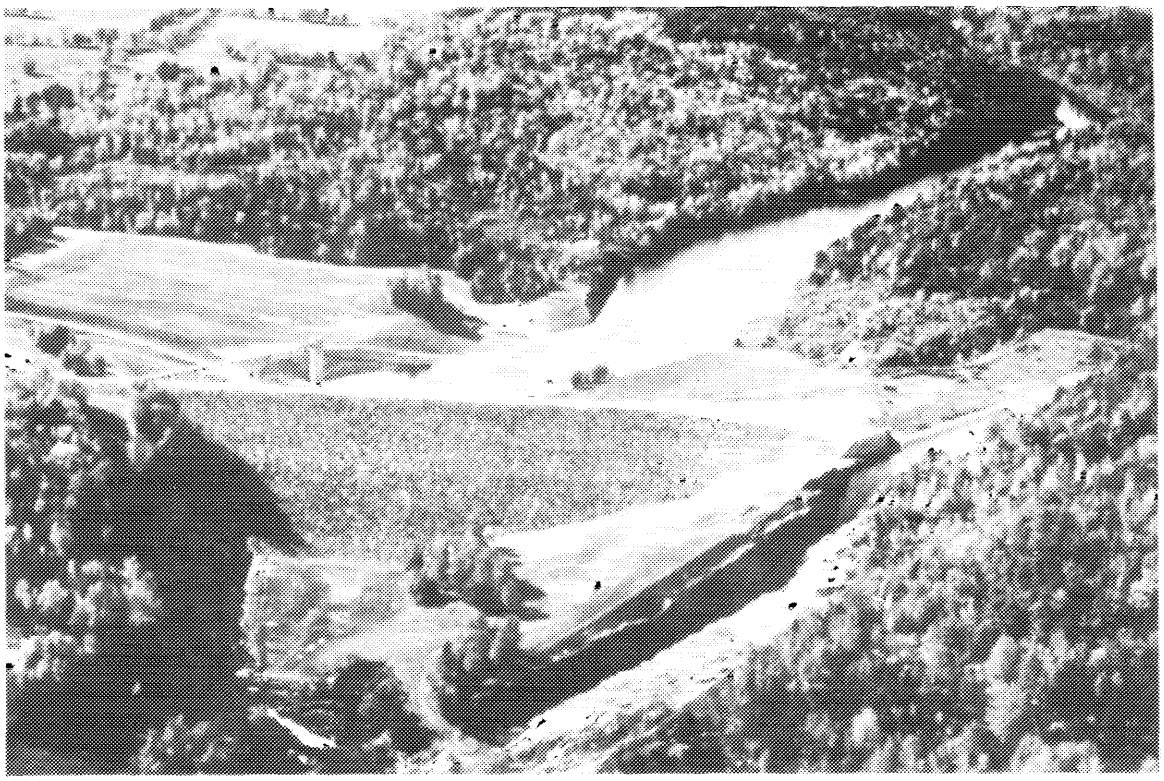
The heavy precipitation associated with this event caused major flooding in the watersheds of Vermont and New Hampshire that drain the Green and White Mountains. In the Connecticut River Basin this event was the largest record summer flood (June, July, August) in many of the tributaries in Vermont and northern New Hampshire. In several of these watersheds such as the Passumpsic, Ottauquechee, Black and Ammonoosuc Rivers, the flood discharges exceeded or approximated the devastating floods of November 1927 or March 1936. In addition, the Connecticut River from Wells River, Vermont to Montague City, Massachusetts reached its highest known summer levels.

In the Merrimack River Basin, the flood was significant and damaging only in the Pemigewasset River watershed upstream of the Franklin Falls Dam. Flooding also occurred in the White Mountain headwaters of the Saco River Basin in New Hampshire. The Naugatuck River watershed in Connecticut experienced flooding on the small unprotected streams. A summary of June-July flood peak discharges at selected U.S. Geological Survey gaging stations are compared with previous floods of record in Table 2.

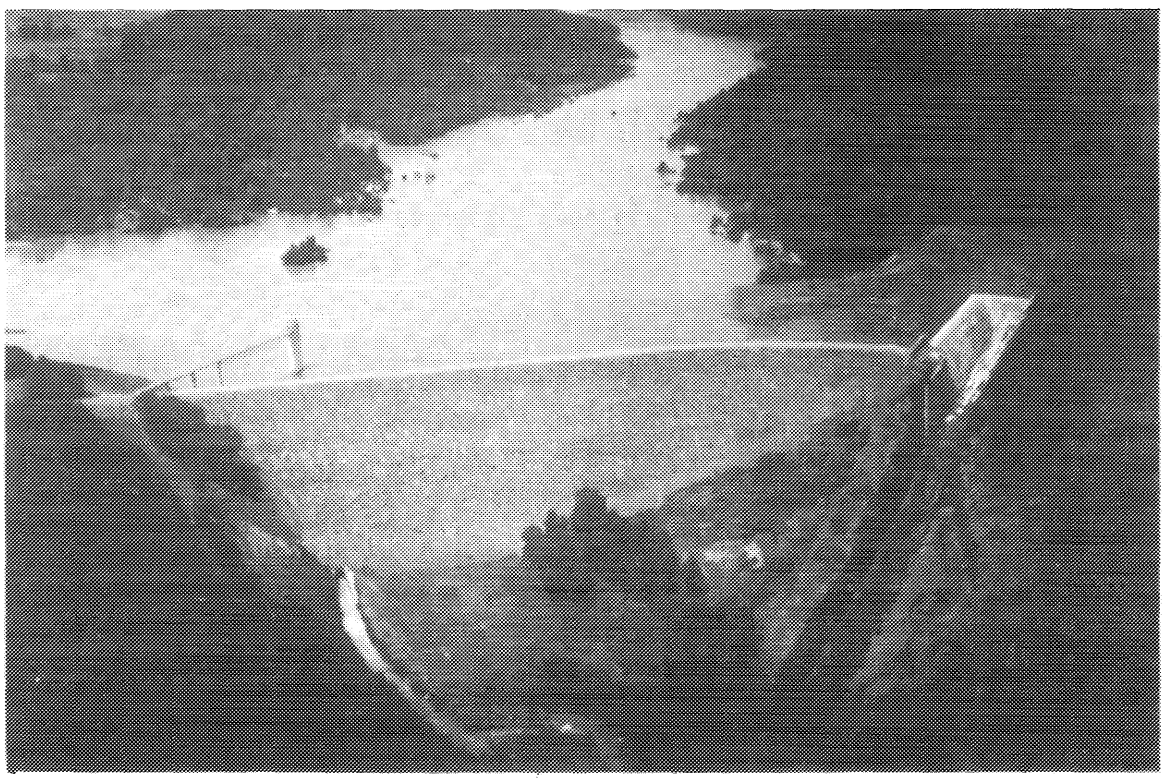
B. RESERVOIR REGULATION.

1. General. All 21 gated Corps of Engineers reservoirs in the Connecticut, Merrimack and Naugatuck River Basins were operated during the flood period and stored significant amounts of runoff. Near record heights were experienced at Franklin Falls, Union Village, North Hartland, North Springfield, Ball Mountain and Townshend Reservoirs. The rainfall total of 2-3 inches in the Thames and Blackstone River Basins did not however, create flood conditions, and no significant reservoir storage was utilized. A tabulation of maximum reservoir levels reached during the flood is shown on Table 3.

2. Connecticut River Basin. The five Vermont reservoirs bore the brunt of this event, and significant flooding occurred in the upstream watersheds, with storage utilized by the five projects averaging 50 percent. Lesser amounts of storage were used in the remaining reservoirs. In general, the Corps of Engineers reservoir system lowered Connecticut River flood levels by 4 to 5 feet between North Walpole, New Hampshire and Montague City, Massachusetts; 3 to 4 feet from Montague City to Springfield, Massachusetts; and 2 to 3 feet from Springfield to Hartford, Connecticut.



North Hartland Reservoir, Connecticut River Basin.
Permanent pool (before)



and 50% full (after)

TABLE 2

SUMMARY OF PEAK DISCHARGES FOR SIGNIFICANT FLOODS

Gaging Station	Drainage Area (sq. mi.)	Nov. 1927 (cfs)	March 1936 (cfs)	Sept. 1938 (cfs)	June-July 1973 (cfs)
Connecticut River Basin					
Passumpsic River at Passumpsic, Vt.	436	42,500	16,000	7,700	18,200
Ammonoosuc River at Bath, N. H.	395	-	27,900	26,800	37,000
White River at West Hartford, Vermont	690	120,000	45,400	47,600	42,300
Ottauquechee River at North Hartland, Vt.	221	30,400	19,200	24,400	31,000*
Black River at North Springfield, Vt.	158	-	14,700	15,500	24,000*
West River at Newfane, Vermont	308	45,000	39,000	52,300	35,000*
Connecticut River at White River Jct., Vt.	4,092	136,000	120,000	82,400	86,000*
Connecticut River at Vernon, Vermont	6,266	155,000	176,000	132,500	122,000*
Connecticut River at Montague City, Mass.	7,865	179,000	236,000	195,000	124,000*
Merrimack River Basin					
Pemigewasset River at Woodstock, N. H.	193	(October 1959 - 47,000)			29,900
Baker River near Rumney, N. H.	143	25,900	19,100	15,900	11,000
Pemigewasset River at Plymouth, N. H.	622	60,000	65,400	50,900	47,600
Merrimack River at Franklin Jct., N. H.	1,507	63,000	83,000	59,200	55,000*
Other					
Saco River near Conway, N. H.	386	-	40,600	20,800	35,000

* Estimated Natural Discharge Without Corps Reservoirs

TABLE 3

MAXIMUM RESERVOIR LEVELS
DURING JULY 1973

Project	Drainage Area (sq.mi.)	Level Elevation (msl)	Level Stage (ft)	% Full
Connecticut Basin				
Union Village	126	516.8	96.8	33
North Hartland	220	503.9	113.9	50
North Springfield	158	529.5	77.5	66
Ball Mountain	172	923.3	177.8	59
Townshend	106 (net)	523.1	66.1	41
Surry Mountain	100	516.6	31.6	21
Otter Brook	47-	723.4	40.4	14
Birch Hill	175	830.0	15.0	14
Tully	50	643.7	18.7	9
Barre Falls	55	779.8	18.8	6
Knightville	162	551.1	71.1	21
Littleville	52	530.8	-	18
Colebrook	118	716.7	-	13
Merrimack Basin				
Franklin Falls	1000	369.5	69.5	66
Blackwater	128	549.0	34	21
MacDowell	44	923.8	19.8	25
Hopkinton	382 (net)	392.0	26	(
Everett	44	354.3	29.3	(7
Naugatuck Basin				
Thomaston	71 (net)	426.1	46.1	9
Black Rock	20	461.7	51.7	13
Hop Brook	16	339.0	47.0	28

3. Merrimack River Basin. This event was a large and damaging flood only in the Pemigewasset River watershed upstream of Franklin Falls Dam. Regulated releases at Franklin Falls were kept to a maximum of 14,000 cfs due to downstream agricultural conditions (18,000 cfs is the normal maximum release rate during the nonagricultural season). Releases at other reservoirs were regulated primarily to maintain Merrimack River levels below flood stages from Penacook, New Hampshire to the mouth. The reservoir system (principally Franklin Falls Dam) effectively lowered Merrimack River levels from 13 feet at Franklin Junction, New Hampshire to 4 feet at Lowell, Massachusetts.

4. Naugatuck River Basin. Rainfall during this period consisted of scattered heavy shower activity for several days. Although reservoir storages were somewhat utilized, no serious flooding occurred on the larger or moderate sized water courses.

5. Effects of Reservoir Regulation. A tabulation of river stage and/or discharge reductions at selected locations in the Connecticut and Merrimack River Basins is located in Table 4.

6. Problems in Reservoir Areas.

(a) Effects of Impoundments on Vegetative Cover. This flood occurred during the growing season and inundated large reservoir areas for periods of 1 to 2 weeks at the five Vermont dams and Franklin Falls. A large accumulation of silt and debris was carried into the immediate areas upstream from the dams. The debris was summarily removed, but the silt remained for an extended period and formed a thin film over all inundated vegetation. The effects of both inundation and silt film on tree life in these reservoir areas are being investigated and a report by the U.S. Army Cold Regions Research & Engineering Laboratory (CRREL) is scheduled for completion by September 1974.

(b) Effects on Recreation Facilities. In the Connecticut, Merrimack and Naugatuck reservoirs the recreational facilities, i.e., beach areas, camping grounds, change houses, roads and culverts were severely damaged during this flood, resulting in limited use of the facilities during the summer months of 1973.

7. Flood Control Benefits. The estimated damages prevented by the reservoirs and local protection projects during this flood were significant and are briefly summarized as follows:

Connecticut River Basin - $27 million
Merrimack River Basin - $ 3 million

TABLE 4

EFFECT OF RESERVOIR REGULATION
AT SELECTED LOCATIONS
27-30 JUNE 1973

Location of Gaging Station	Experienced Conditions Discharge (cfs)	Natural Conditions Discharge* (cfs)	Stage Reduction (feet)
Connecticut River Basin			
Ompompanoosuc R. at Union Village, Vt.	1,800	9,500	6±
Ottauquechee R. at North Hartland, Vt.	4,800	31,000	13±
Black River at North Springfield, Vt.	3,300	24,000	12±
West River at Jamaica, Vermont	4,100	31,000	8±
West River at Newfane, Vermont	5,300	35,000	10±
Connecticut R. at White River Jct., Vt.	80,400	86,000	1.5
Connecticut R. at North Walpole, N. H.	88,700	112,000	5
Connecticut R. at Vernon, N. H.	102,000	122,000	4
Connecticut River at Montague City, Mass.	98,600	124,000	4.5
Connecticut River at Hartford, Conn.	21.0 ft.	23 ft.	2
Merrimack River Basin			
Franklin Falls Dam	14,000	50,000	-
Merrimack River at Franklin Jct., N. H.	18,600	55,000	13.5
Merrimack River at Concord, N. H. (Routes 93 & 4)	24,000	57,000	5
Merrimack River at Goffs Falls, N. H.	30,700	62,000	6.5
Merrimack River at Lowell, Mass.	37,600	63,000	4

* Without Corps of Engineers Reservoirs

White River Junction, Vt.

Bridge and Railroad Beds became victims of surging water.

Bradford, Vt. - Rt. 25 bridge crossing the Connecticut River.

II. "THE MORNING AFTER".

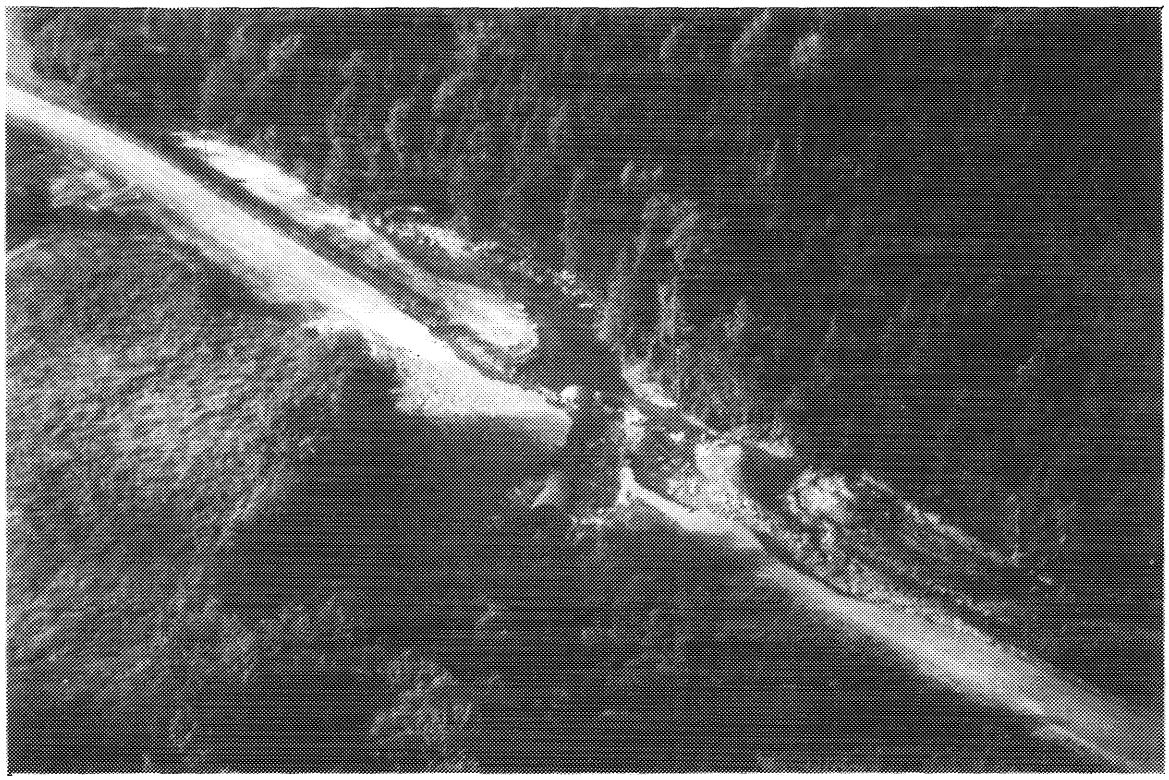
The month of June 73 appeared to be a normal early summer month for New England precipitation. Scattered rainshowers had fallen throughout the month, but no significant rainfall had occurred. When the rain started falling Wednesday night, 27 June, no one in New England anticipated more than another band of heavy summer showers. New England Division's Water Control Branch, Reservoir Control Center (RCC) cast its usual wary eye on weather predictions coming over its National Weather Service teletype in an effort to avert any flooding trouble that might develop. But by Thursday night hydrologic data from NED's water control projects indicated a subsidence of rainfall in western Connecticut and Massachusetts with only some localized high water areas apparent. The weather situation did not seriously deteriorate on Friday. NED's Automatic Hydrologic Radio Reporting Network (AHRRN) confirmed no significant precipitation in New England, and the National Weather Service predicted only scattered heavy showers for the weekend. The RCC breathed easier, briefed its water control project managers, and presumably closed its doors for the weekend.

A. A DARK SATURDAY MORNING.

"Mother Nature" asserted herself early Saturday, 30 June. Heavy rains blasted the mountain areas in Vermont and New Hampshire. Water Control Branch personnel started receiving telephone calls from project managers as early as 3 a.m. By 7 a.m. storm rainfall was significant enough for the WCB personnel to notify NED Headquarters. The Chief, Engineering Division ordered the NED Reservoir Control Center opened and staffed for emergency conditions. It soon became obvious that flooding would occur in the high mountain-deep valley areas in Vermont and New Hampshire. Division Engineer, Colonel John H. Mason, directed that the Emergency Operations Center under his Deputy, Colonel Charles J. Osterndorf, be fully staffed for emergency assistance to all affected areas in New England.

B. OPERATIONS DURING HIGH WATER.

As rainfall estimates and initial damage reports were received at the Emergency Operations Center, NED personnel compiled the data and made swift decisions concerning where and how much help was needed, and what kind would be most efficiently useful and applicable. Liaison and



Insufficient culvert capacity caused many washouts.

Highway near White River Junction, Vt.

communications were established with both Vermont and New Hampshire State Officials. A four man, water quality team was put on alert Saturday evening and was dispatched to North Springfield, Vermont on Sunday morning. The team spent the next eight days running 510 water quality analyses for 52 communities in 7 counties in Vermont.

NED requested and received the use of a First Army helicopter during the subsequent three days' activities. The helicopter provided needed mobility for the Division Engineer who personally coordinated NED assistance with the Governors of Vermont and New Hampshire. During the helicopter's availability, NED engineers made flights which obtained timely and accurate information concerning the extent of damage to many publicly and privately owned dams.

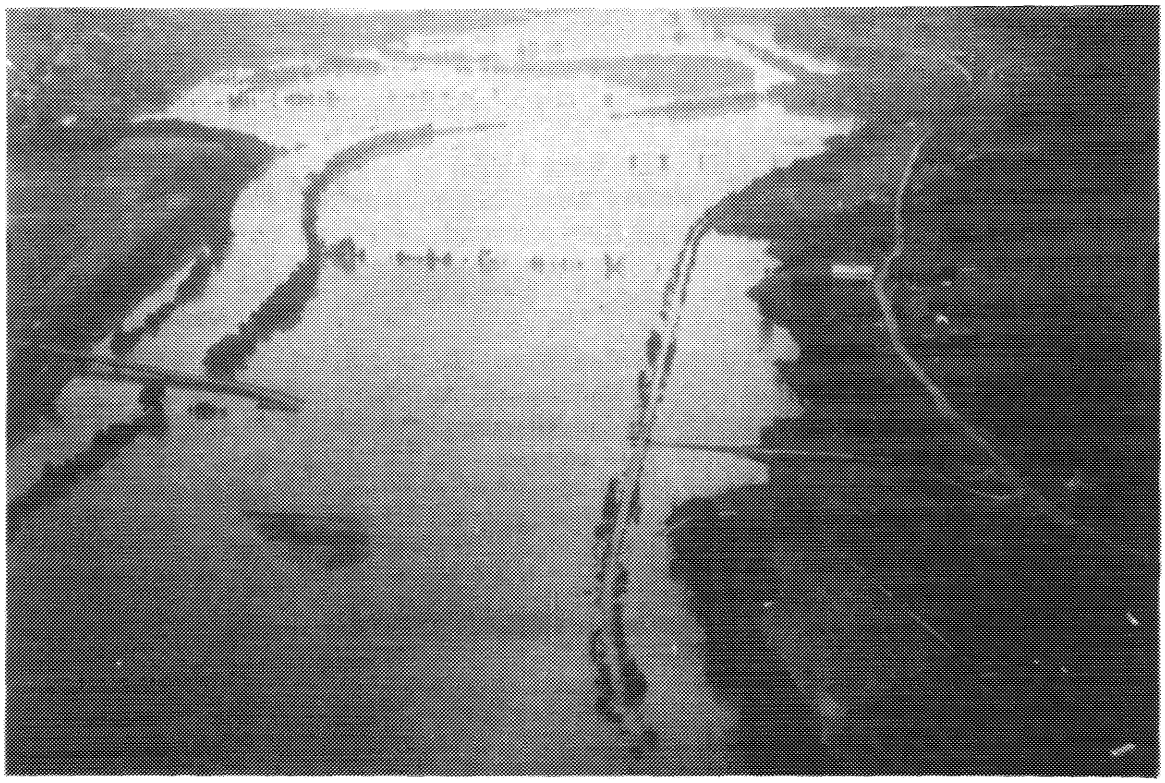
The Public Affairs Office poured information into the New England Regional Wire Services to keep a shaken and soaked population informed of crucial developments. Local media in affected areas were kept continually aware of the Corps' activities with respect to water control and reservoir discharges. The PAO developed a number of feature articles for the New England press which highlighted NED's flood control capabilities and activities and emphasized NED's immediate response capability to flash flooding through the use of its Automatic Hydrologic Radio Reporting Network.

As Emergency Operations personnel painted the bleak picture of the storm's fury in Northern New England, it became apparent that the majority of damage to buildup areas and farmland was situated on or near uncontrolled tributaries in the Connecticut and Merrimack River Basins.

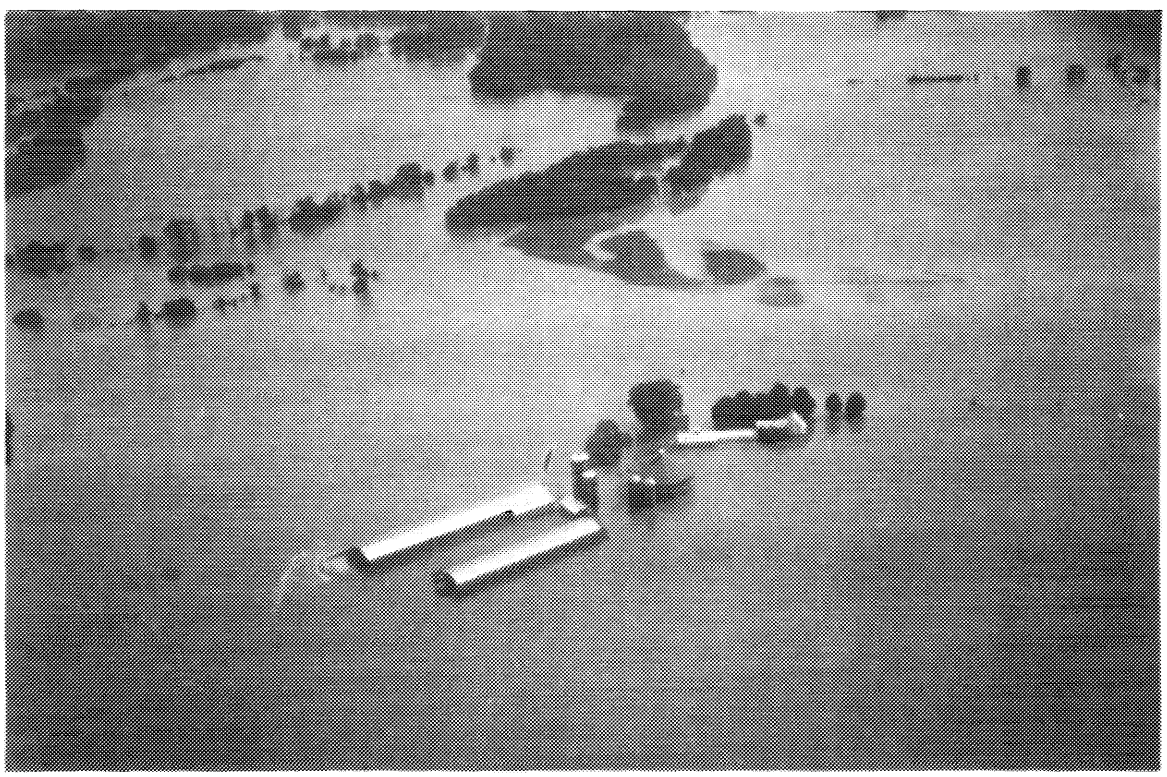
C. THE DISASTER DECLARED.

As the water receded on Monday, 2 July, the devastation of the storm became fully visible. Vermont had sustained the heaviest damages, but New Hampshire had also absorbed a healthy share of destruction from the hydrologic onslaught. The Federal Disaster Assistance Administration (FDAA) directed NED to make "Windshield Estimates" of the damage in both states. A summary of the estimates is presented in Table 5.

Newbury, Vt. - Connecticut River Flood Plain



Agricultural Inundation



Wells River, Vt. - Dairy Farm

TABLE 5

"WINDSHIELD ESTIMATES"

for

Debris/Stream Clearance, Emergency Protective Measures,

Water Control Facilities

	As of 14 July 1973	
	NED	NYD
VERMONT	$2,873,000	$1,834,000
NEW HAMPSHIRE	$1,172,000	
CIVIL WORKS PROJECTS	$ 168,000	
Total	$6,047,000	

With the facts and figures at their disposal Governor Thomas P. Salmon of Vermont and Governor Meldrim Thomson, Jr. of New Hampshire requested the President to declare their states disaster areas. Presidential confirmation came quickly. The FDAA came to the Corps with mission assignments in both states to make damage surveys of all storm related damage in the categories of debris/stream clearance, emergency protective measures, and repair and restoration of water control facilities.

III. "THE CORPS CARES" IN ACTION.

NED response to the FDAA requests for assistance was already in motion when the written mission assignments came off the press. The organization for emergency support to Vermont and New Hampshire, presented in Chart 1, set up State Coordinating Offices in both state capitals with a military liaison in each office. Damage survey teams received assignments from, and were directly responsible to, the NED State Coordinating Offices. Due to many requests from the Vermont and New Hampshire Water Resource Boards and from local applicants, NED activated a special dam safety inspection team to examine and make recommendations for repairs to, and/or reconstruction of, water impounding facilities which were damaged by the storm and which met certain minimum criteria. The minimum criteria, adopted from PL 92-367, was: the facility is 25 feet or more in height and impounds 50 or more acre-feet of water. This criteria established a division of the inspection workload between the NED team and the states' water resource engineers. It gave the Corps team the freedom it needed to inspect on a priority basis the most critical SAFETY hazards concerned with water impoundment facilities.

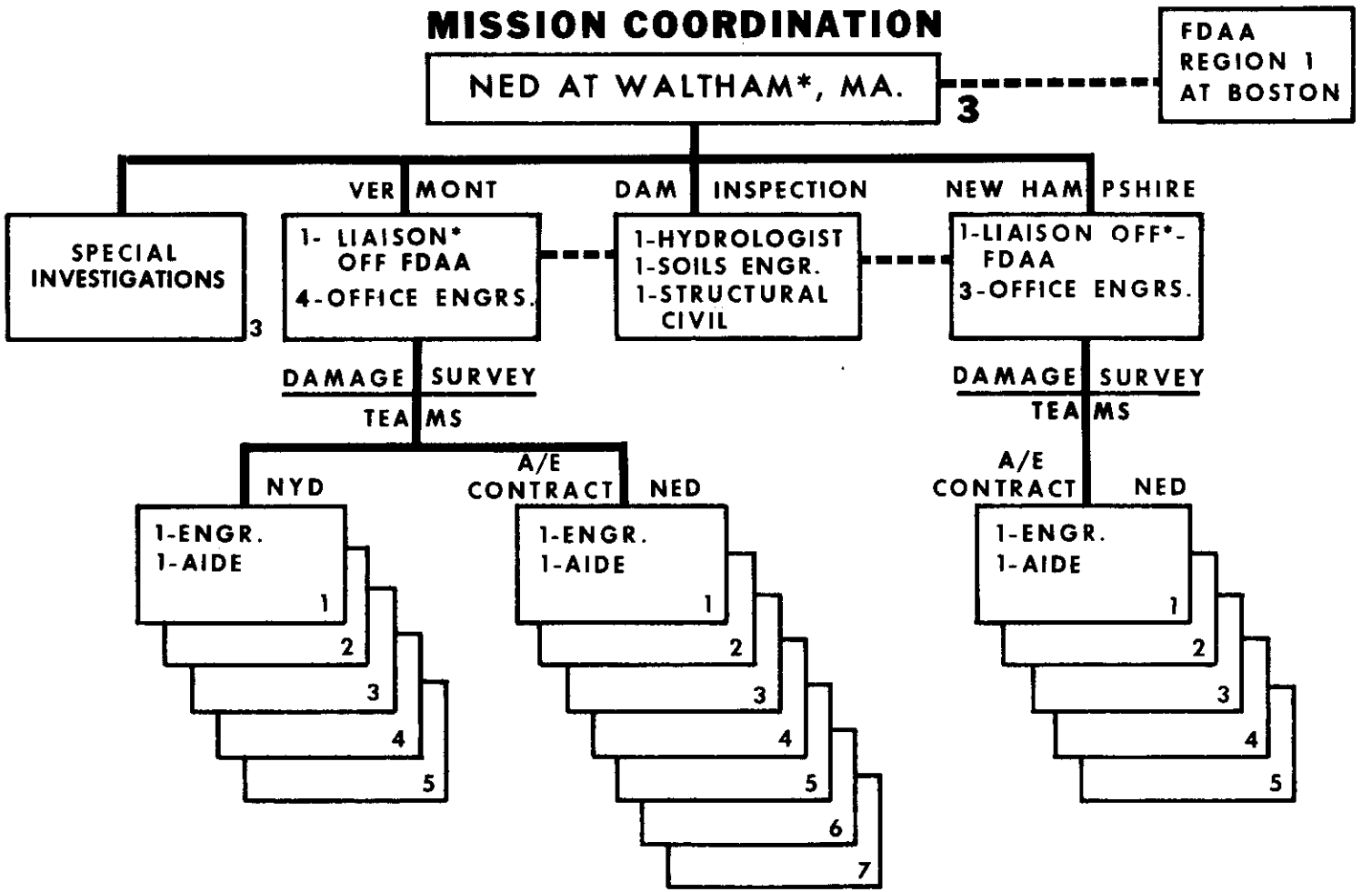
A. ACTIVITIES UNDER PUBLIC LAW 91-606.

New England Division cadre moved out and set up their offices in the state capitals as the Deputy Division Engineer solicited assistance for damage survey preparation from other Civil Works Divisions. Due to the Corps' heavy commitments in the Mississippi Valley and the Great Lakes areas, substantial sister Division response was not forthcoming. New York District, North Atlantic Division did, however, supply ten personnel to prepare damage surveys within their Civil Works boundary in Vermont. Coordination with North Atlantic Division and New York District resulted in NED being the single point of contact for the Corps to the FDAA in the state of Vermont for this disaster. New York District agreed to send their personnel in a TDY status to NED for this purpose.

1. Extent of Damage. The storm's path thru New England was generally northeast moving with less intensity through western Connecticut and Massachusetts and finally with its greatest intensity in south-central Vermont and central New Hampshire. NED's efforts were directed first toward the hardest hit counties in the two states; Bennington, Rutland, Washington and Windsor counties in Vermont and Coos, Grafton and northern Sullivan counties in New Hampshire. The other counties, though having possibly high dollar damage figures, had only localized severe damage which was investigated on a case by case basis. Table 6 gives a breakdown of damage figures by county. The two foldout maps (Pages 21 and 22) depict, by shading, the towns which sustained damage.

CHART 1

COE EMERGENCY SUPPORT TO VERMONT & NEW HAMPSHIRE JULY-AUGUST 1973



*COMMISSIONED OFFICER

TOTAL=52 PERSONNEL

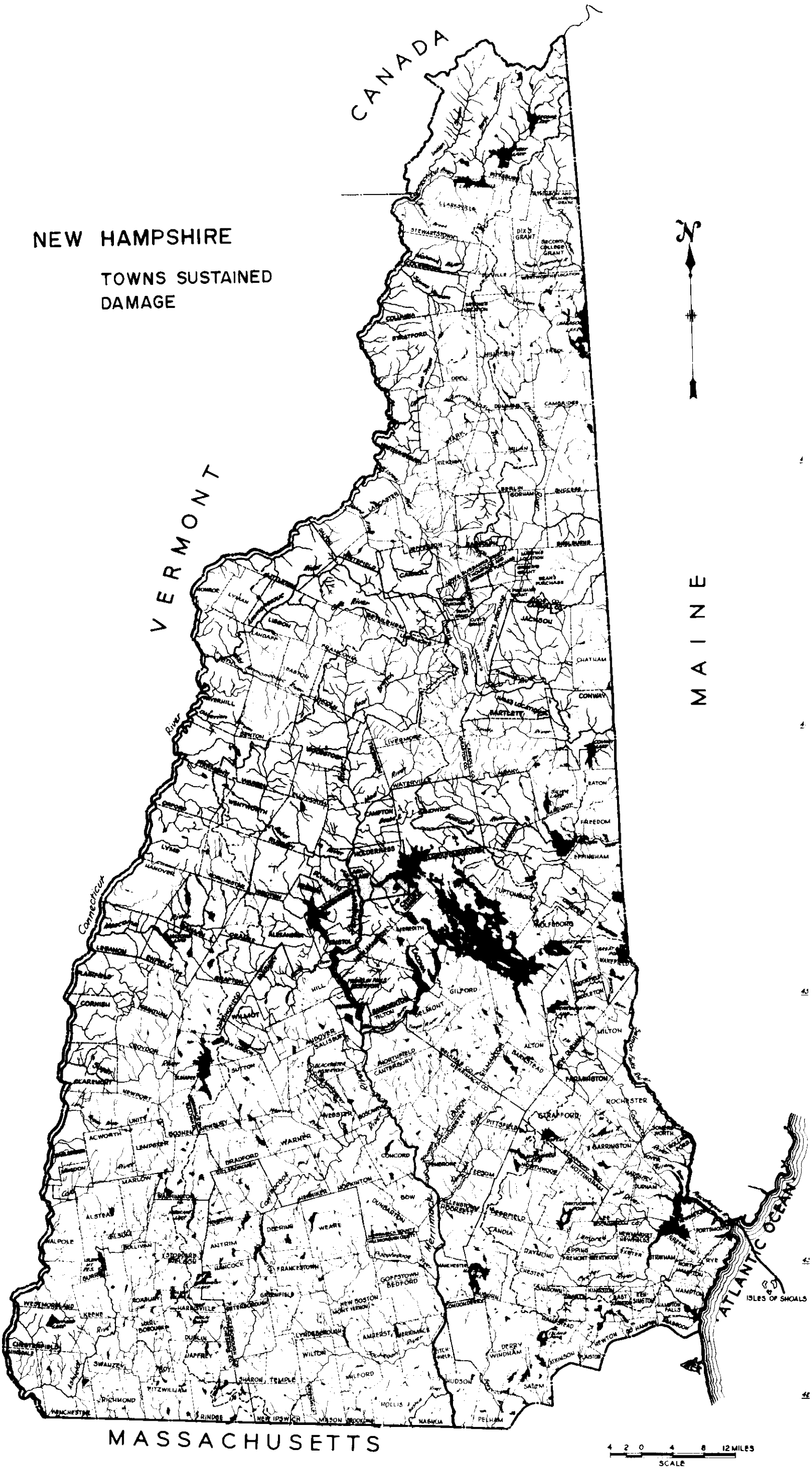
TABLE 6

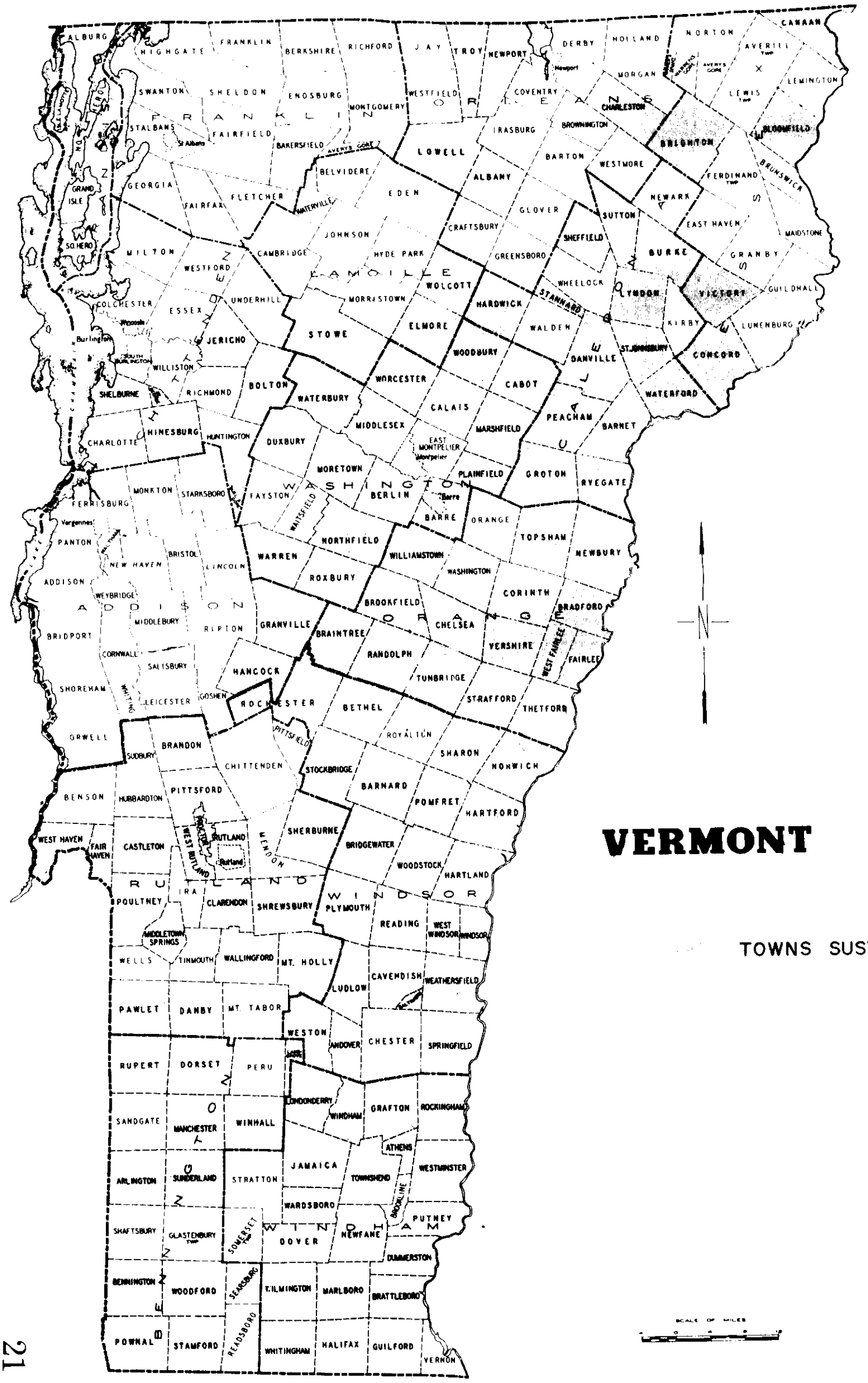
COUNTY DAMAGE FIGURES

County	COE DSR's	Dollar Value
VERMONT		
Addison	4	$ 7,164
Bennington	27	66,293
Caledonia	90	177,704
Chittenden	25	30,034
Essex	13	18,583
Franklin	0	0
Lamoille	8	3,741
Orange	109	176,083
Orleans	19	12,999
Rutland	171	342,223
Washington	89	231,897
Windham	198	146,153
Windsor	342	976,685
	1,095	$2,189,559
NEW HAMPSHIRE		
Belknap	23	$ 64,521
Carroll	33	79,471
Cheshire	5	7,660
Coos	34	266,443
Grafton	105	438,642
Hillsborough	2	776
Merrimack	9	69,556
Rockingham	1	177
Strafford	3	1,809
Sullivan	27	72,654
	242	$1,001,709

NEW HAMPSHIRE

TOWNS SUSTAINED
DAMAGE





VERMONT

TOWNS SUSTAINED DAMAGE

2. Damage Survey Effort. The damage survey preparation effort in Vermont involved twelve DSR teams the first six weeks and two teams the last two weeks; and in New Hampshire involved five DSR teams the first three weeks and one team the last week. NED expended the majority of its time investigating debris/stream clearance, emergency protective measures, and water control facilities. The New Hampshire office honored specific requests from the FDAA to investigate roads, public buildings, and public utilities, when the NED office deemed it more advantageous to the government that it perform the service rather than the FDAA bring in another Federal agency for a "one time" estimate. Table 7 summarizes NED's total activity in Vermont and New Hampshire by damage category and dollar related amounts.

TABLE 7

COE DAMAGE SURVEY REPORTS

Category	New Hampshire		Vermont	
	#DSR's	Dollar Value	#DSR's	Dollar Value
Debris/Stream Clearance	148	$448,151	481	$1,002,879
Emergency Protective Measures	37	70,934	572	826,653
Roads	5	5,897		
Water Control Facilities	35	466,376	42	360,027
Public Buildings	4	3,677		
Public Utilities	13	6,674		
	242	$1,001,709	1,095	$2,189,559

The following summary shows the dollar value deviations between COE DSR estimates and COE "Windshield Estimates".

	DSR's	Windshield Estimates	% DSR's/W. Est.
Vermont	$2,189,559	$4,707,000	47%
New Hampshire	$1,001,709	$1,172,000	85%

Analysis indicates that higher dollar values for "Windshield Estimates" were influenced by:

(a) The very short time period in which the estimating teams were required by the FDAA to make state-wide damage assessments.

(b) The tendency of the teams to estimate on the high side for damaged structures which, at that time, were still partially inundated or which could not be closely examined because of continued adverse weather conditions.

(c) The tendence of the teams to include ALL located damage in COE designated catagories since there was little time to ponder and decide upon specific eligibility.

B. STATE COORDINATING OFFICE.

1. Staff. The magnitude of damage dictated the number of personnel needed to implement and administrate mission assignments from the FDAA. Although New Hampshire had sustained less damage than Vermont from the flood, the Corps office organizations were similar. An initial organization is presented in Chart 2.

A significant observation in staffing the state offices concerned the span of control that the office could efficiently render over the damage survey teams. NED found it necessary to include an Area Coordinator for up to four teams. This individual reviewed and returned DSR's if necessary to his teams for further work, signed DSR's as the Federal representative when Architect-Engineer or new Corps personnel initiated them, and settled the majority of problems with applicants at the local level. The Area Coordinators saved innumerable man-hours at the State Coordinating Office level by forwarding only significant problems to be solved at the state level, and by allowing only administratively complete damage survey reports to be passed on to the state office. The state review staff had only to check estimates, review and catalogue DSR's administratively, send the DSR's to the FDAA, and solve only the significant and/or controversial problems of applicants.

Depending on the number of DSR teams that were needed in any one major political entity (county, state), a scaled COE organization, as presented in Table 8, was found to be necessary. The modified Corps office organization including the Area Coordinators is shown in Chart 3.

TABLE 8

COE SCALED STATE ORGANIZATION

DSR Teams	1-4	5-8	9-12	13-16	17-20
Area Coordinators	0	1	2	3	4
#Personnel in Review Team	2	3	3	4	4
Emergency Opns. Coord. (Military)	1	1	1	1	1

(1) The DSR teams are 2-man teams (NED or AE).

(2) The Area Coordinator is a COE employee well versed in PL 91-606 and in current FDAA policy.

(3) The military "Emergency Operations Coordinator" and his review staff are located near or at the state capital.

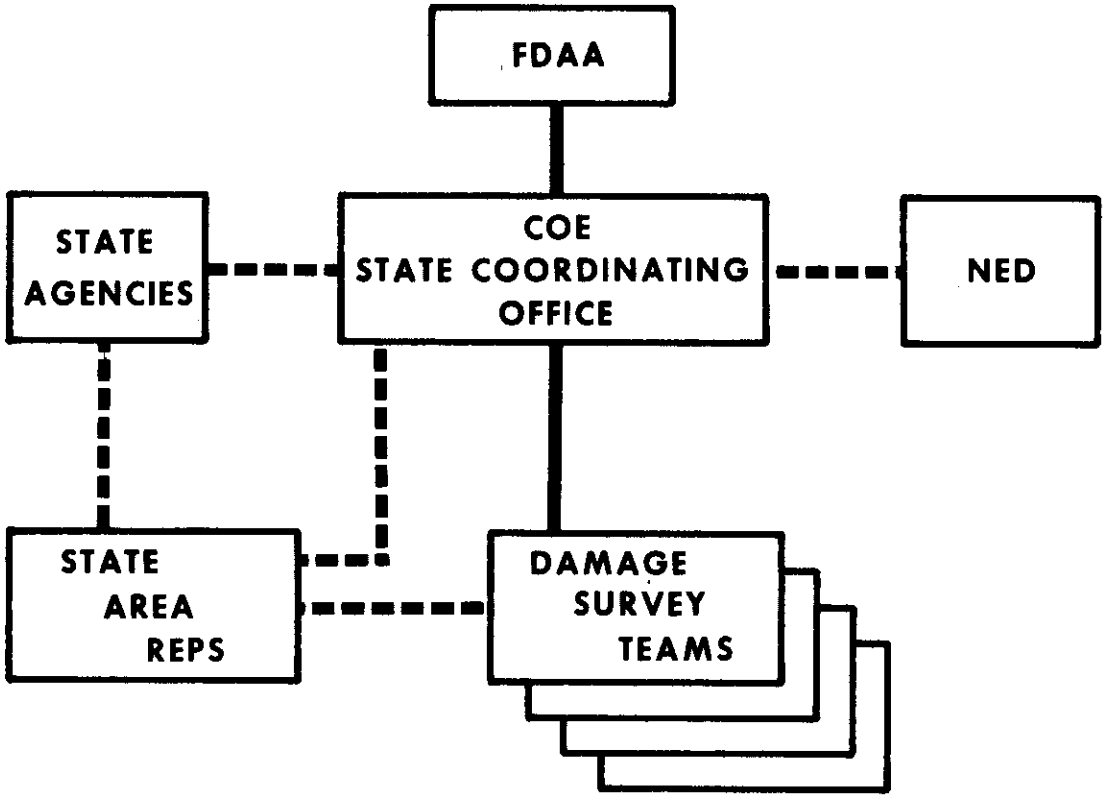
(4) The review staff consists of estimators and secretaries, as needed, and are well versed in Local Procurement, PL 91-606 and in current FDAA policy.

During the initial staffing process, NED established that personnel should be assigned to a State Coordinating Office for a minimum of 45-60 days in order to add continuity to the organization. The state offices confirmed that it was much easier and less disrupting to overstaff the organization initially than to add personnel to a mission assignment already in progress.

2. Applicant Reaction Time. In New Hampshire and Vermont, this flood disaster was for some local applicants their first introduction to PL 91-606. NED noted that the time allotted the local applicants to be briefed on, absorb information about, and react to the law's requirements was less than 2-3 days in some cases. This proved to be insufficient and slowed initial COE damage inspection progress.

CHART 2

INITIAL
STATE COORDINATING OFFICE
ORGANIZATION

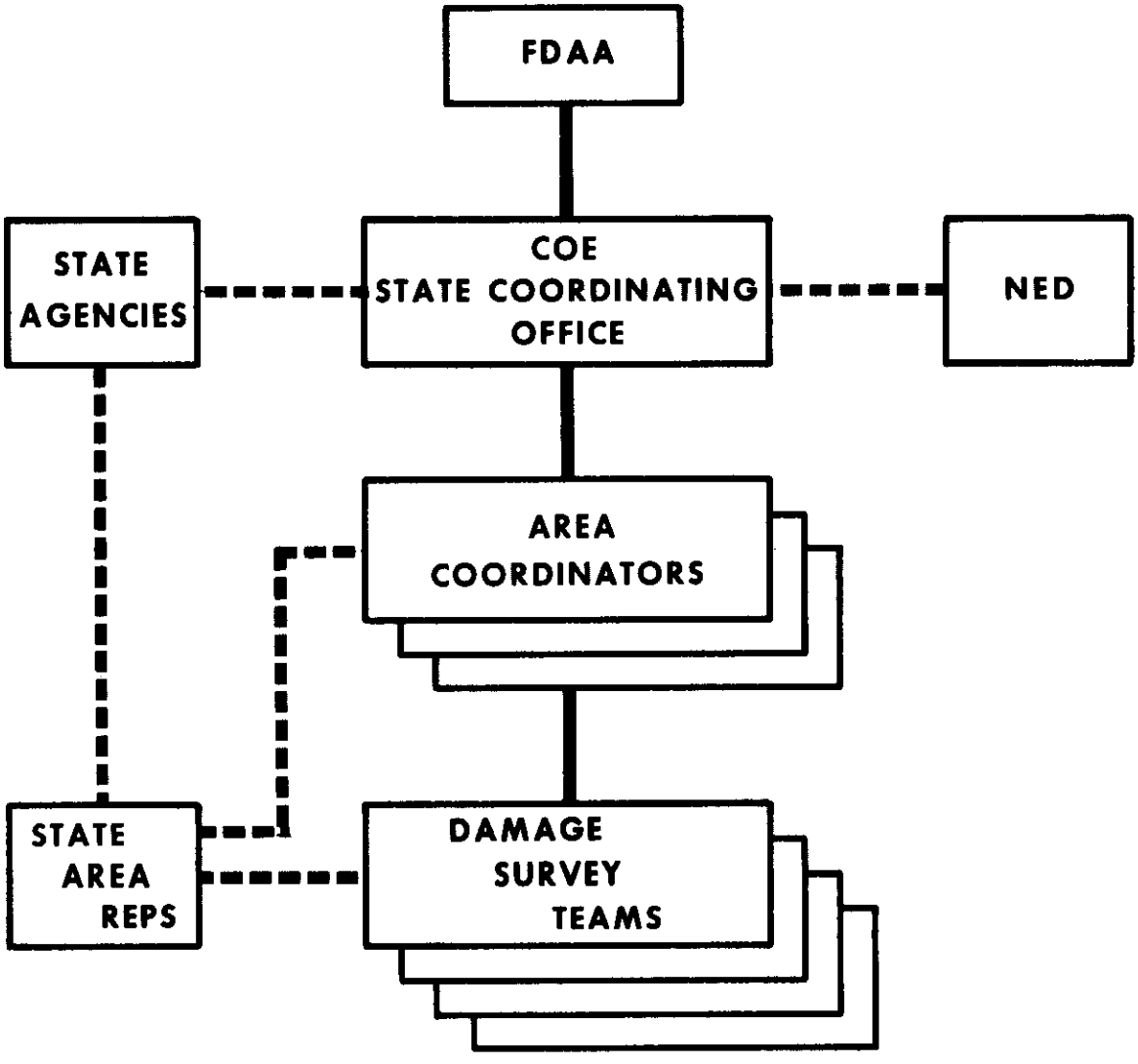


DAILY COMMAND/CONTROL

DAILY COORDINATION

CHART 3

MODIFIED STATE COORDINATING OFFICE ORGANIZATION



3. Administration. The State Coordinating Offices generated the following "in-house" summary sheets which assisted in the flow of statistical information to other headquarters, and which streamlined bookkeeping activities.

(a) Applicant DSR Summary Sheet. The immediate need for a "staging document" to keep daily progress on DSR movement from the initiating DSR team to FDAA was evident and necessary. A sample of the final version of this sheet is Inclosure 1.

(b) Daily Team Location Sheet. The need for a condensed location sheet for all DSR teams was proportional to the number of teams active in the field. The format for this sheet was designed to suit the situation and number of teams.

(c) Hazardous Dam Summary. Due to the magnitude and extent of damage at water impoundment locations, a combined SAFETY inspection priority sheet and COE dam inspection team progress sheet was essential. Using the format in Inclosure 2, the State Coordinating Offices scheduled priority inspections and recorded all immediate, emergency or routine actions taken.

4. DSR Team Coordination. In order that the State Coordinating Office be daily cognizant of each team's progress, the Area Coordinator and/or individual teams called the State Coordinating Office at least once daily. The minimum information given was:

(a) Town working in
(b) Location (motel) and telephone working from
(c) Accomplishments for the day, i.e. number of DSR's written, categories, dollar value
(d) Problems
(e) Finalize plans for the following day
(f) State Coordinating Office passed on any further information and/or instructions.

A log was kept on ALL calls.

STATE: _____

TOWN: _____ COUNTY: _____

OR (POLITICAL ENTITY)

DSR SUMMARY SHEET

CAT	ITEM	PREPARED BY (TEAM)	DATE PREPARED	DATE SUBMITTED TO C.O.E. STATE OFF.	DATE SIGNED BY APPLICANT	DATE FORWARDED TO FDAA	AMOUNT
							INCL. 1

STATE: _____

SHEET ___ OF ___

HAZARDOUS DAM SUMMARY

COUNTY - CITY - RIVER	REPORTED DAMAGE	PRIORITY	DATE INSPECTED	ACTION TAKEN

INCL. 2

C. ARCHITECT-ENGINEER SUPPLEMENTATION.

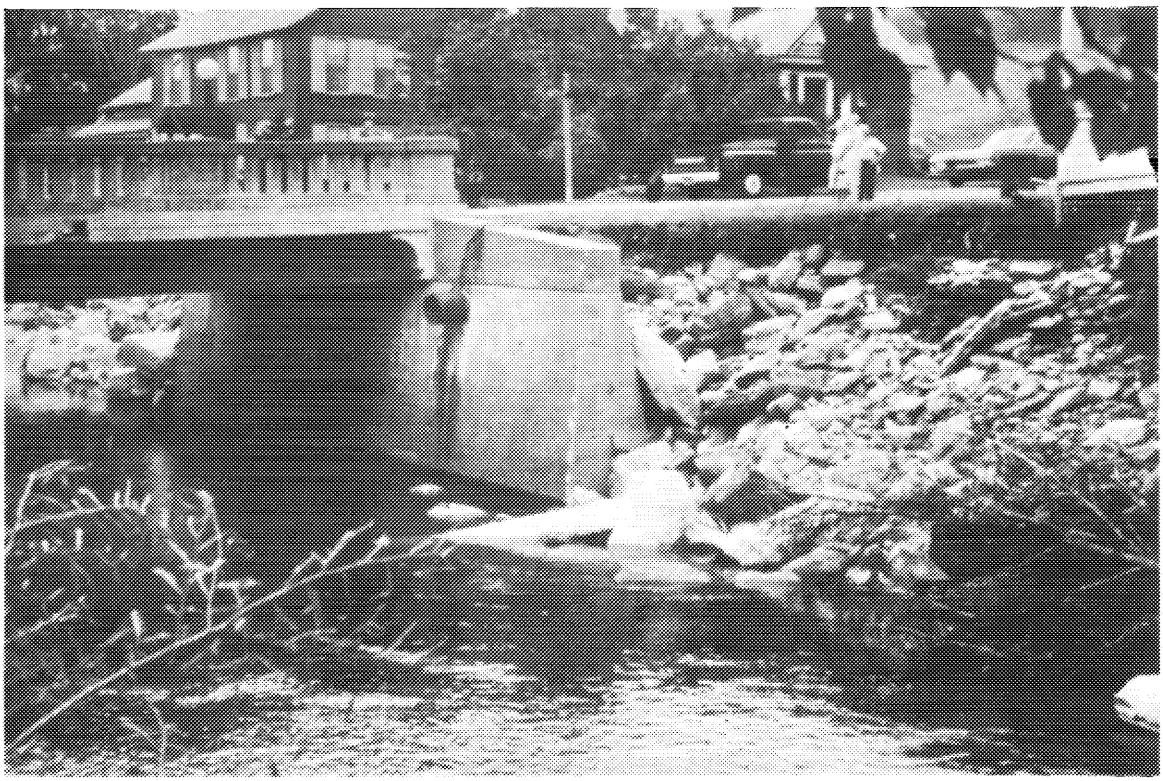
Corps related damage recovery estimates in excess of $6,000,000; personnel commitments to the Mississippi Valley, the Great Lakes, and NED Atlantic coastal disaster areas; and a heavy essential personnel commitment to the Charles River Dam project were principal contributing factors necessitating NED's decision to seek additional personnel assistance. New York District's ten man contingent supplied damage estimation coverage within their Civil Works boundary in Vermont. The balance of the State of Vermont and all of the State of New Hampshire were covered by four Architect-Engineering firms who were awarded standard, negotiated Service Contracts to produce "Damage Survey Reports".

1. Contract Explanation. The contract special provisions included working under a Project Officer (NED State Coordinating Officer), providing their own transportation, supplies, cameras, film and engineering design, and working a fifty-eight (58) hour work week. Proposals, awards, and payments were made on a cost/team-day basis. The firms were given one day of training in Public Law 91-606. The contracts' "NOTICE TO PROCEED" depended on (1) the Presidential Declaration date, (2) the FDAA/State agreement, and (3) the FDAA/State preparation and education of local and state applicants.

2. Team Preparation. The initial day for Architect-Engineer personnel not familiar with COE organization and with Public Law 91-606 was spent at NED's Emergency Operations Center in Waltham, Massachusetts. The personnel received six hours of instruction, and were then released to their state assignments. Subjects covered in the classes were:

(a) Explanation and Discussion of PL 91-606
(b) The Present State Disasters and how the Public Law Renders Assistance
(c) The COE Mission Assignments
(d) The Architect Engineers' Duties as Part of these Assignments
(e) The applicants' Manual and Eligibility
(f) The Damage Survey Report

Though a multitude of subjects and much material was covered in one day, NED established that it was necessary to get the teams into the field immediately to obtain an initial batch of DSR's upon which to review and set policy. Within seven days all teams had submitted and had had reviewed an initial set of DSR's.



Weston, Vt. - Storm damage to highway bridge

and rehabilitation of bridge and West River channel slopes.

Periodic meetings were called at the State Coordinating Office level for individual team discussion or for general information sessions as problems arose or policies were implemented by the FDAA.

3. Personnel Acquisition and Performance. Due to the nature of the work and the critically short acquisition time, NED formulated specific personnel hiring criteria in its AE procurement for this endeavor. Consideration was given to companies: that were large enough to absorb the personnel drain without significantly disrupting their own operations; that had the hydrologic and civil engineering expertise readily available; that had performed well in prior civil works projects with NED; and that had high personnel acquisition standards.

As with the principal NED review staffs in the State Coordinating Offices, a 45-60 day initial procurement period for AE DSR team personnel was necessary. This staffing period allowed time for the localities to organize after the flood and to react profitably to the teams' presence in their communities.

The DSR team personnel needed close supervision while the State Coordinating Offices initially set policies and standards. The first two weeks were the most critical during the operation.

NED experienced no significant problem with Architect-Engineer personnel; however, it recognized the need for a clause in the AE Service Contracts which would permit termination if unqualified personnel were provided.

D. RECONSTRUCTION UNDER PUBLIC LAW 84-99.

The high water from the storm severely damaged a local protection project in Weston, Vermont and moderately damaged another in Lincoln, New Hampshire.

1. Weston, Vermont. The original project in 1957 in Weston, Vermont called for channel improvements in the West River amounting to $16,500. The clearing and snagging work opened and deepened the river channel and stabilized the river's banks through the town.

The July storm caused the river to overflow its banks at an old gristmill dam, undermine several buildings in the center of the small town, wash out a main and a few secondary roads, and severely damage both abutments on the highway bridge over the river.

Weston, Vt. - Private Home Damage

Weston, Vt. - Placed stone in West River channel
for improving fish habitat.

In the rehabilitation of the project NED realigned the river channel, stabilized the river banks for 900' ± through the town, and rebuilt the highway bridge abutments at a cost of $140,250. In response to a special request from the Vermont Fish and Game Department, NED randomly placed rocks in the river channel downstream from the bridge to improve fish habitat conditions.

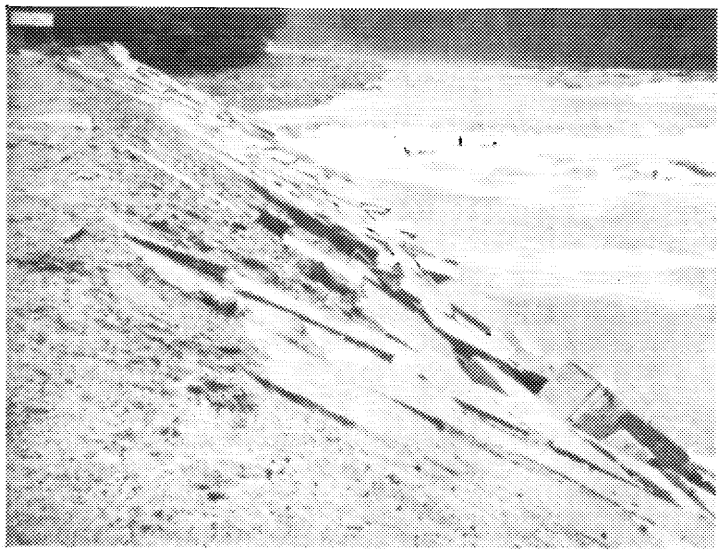
It is significant to note that the original project was designed for a fifteen (15) year recurring flood. The June-July 1973 flood was determined to be a thirty (30) year frequency flood. In the rehabilitation process, the highway bridge was found to be a serious channel constriction. The Vermont State Highway Department is presently considering replacing the old bridge with one which will have a hydraulic capacity equivalent to the portion of the channel upstream from the bridge. This project, however, is contingent upon the Town of Weston completing downstream channel improvements having similar hydraulic capacity.

2. Lincoln, New Hampshire. A significantly larger project was originally undertaken by the Corps on the East branch of the Pemigewasset River, New Hampshire. In 1960 repairs were made on 1350' ± of log crib dike at a cost of $133,600. This project encompassed placing additional bedding stone on the channel side of the dike, establishing a toe in the river channel, and placing cover stone (3 ton minimum) over the existing log crib structure and additional bedding.

The July flood caused a washout approximately 90' ± downstream from a diversion dam which in turn caused undermining of the existing toe on the dike. A 76' ± section of the dike had bedding stone gouged out and had its surface stone disturbed and misaligned. The dike however, did not fail and no flooding occurred as a result of the minimal damage.

NED solicited local contractor expertise to replace the bedding, re-establish the undermined toe, and realign the cover stone at a cost of $20,500.

3. Personnel Training. NED noted that new COE and AE DSR team personnel needed initial instruction, and seasoned Corps personnel needed refresher instruction, in identifying and reacting to PL 84-99 damage. NED experienced an initial lack of coordination with local residents at Weston, Vermont because the first Corps personnel that inspected the flood damage to the local protection project unknowingly gave erroneous information to the local residents concerning the Corp's authorized rehabilitation authority. The misunderstandings that ensued were not serious but they did hinder the Corp's capability for timely response.



Damage on dike.
Looking north toward diversion dam.

Rehabilitation.
Looking south toward town of Lincoln.

IV. ARCHITECT-ENGINEER PRODUCTIVITY.

The use of contract engineer expertise in producing Damage Survey Reports was new in addition to being necessary. Statistics were compiled and costs were evaluated and compared between Corps of Engineer and Architect-Engineer personnel. A report of NED findings for Vermont was rendered to the Deputy Chief of Engineers. The substance of that report is given below.

A. DSR Analysis. 96.2% of the DSR's prepared by the total COE effort in a rural-type disaster (Vermont) were available for this analysis. A summary of the statistics derived from this disaster operation is as follows:

	COE	AE
Teams[1]	5	7
Team days expended	199	309
DSR's prepared	436	659
DSR's prepared/team day[2] (Production Rate)	2.10	2.02
Average Process Time[3]/DSR (days)	16.7	18.2

1 - Two men/team
2 - 6 weeks were concerted effort (10 hr day, 6 days/week)
2 weeks were clean-up effort (8 hr day, 5 days/week)
3 - Process time is from the inspection date on which the DSR was prepared in the field to the forwarding date on which the DSR was forwarded to the FDAA.

Certain factors materially affected DSR preparation and average process time for both the COE and the AE efforts. They were:

(a) FDAA emphasized "cost engineering" rather than "field estimating", thereby requiring more accurate costs and descriptions for the DSR's.

(b) The State of Vermont was unable to adequately staff NED DSR teams, which resulted in return visits to applicants for final signatures.

(c) The COE personnel changes necessitated periodic educational sessions which had to be taught by NED's own review staff. This, coupled with joint trips to the field over controversial DSR's and innumerable coordination sessions with the Federal Highway DSR teams, stretched to the limits the COE State Coordinating Office's review capability.

B. Cost Analysis. In addition to the average process time comparison, a cost evaluation was also made for damage survey teams in the State of Vermont based on partial final billing for COE expenditures vs. AE contract fees.

	COE	AE
Total cost thru 28 Feb 74	$65,578	$125,859
Windshield Estimate Costs (less)	6,500	None
DSR Preparation Cost	$59,078	$125,859
Overhead (plus)	$12,591	(Incl. in Contr)
Total DSR Preparation Cost	$71,669	$125,859
Total DSR's Prepared	436	659
Preparation Cost/DSR	$164.37	$190.98

C. Conclusions.

(a) The production rate of DSR's by COE and AE personnel appears essentially equal.

(b) The difference between average process times for DSR's favors COE personnel by 1.5 days.

(c) The additional processing time (1.5 days) and its associated costs, for the AE effort, may be attributed to increased difficulty in physically getting into and out of the damage areas. This difficulty, attributable to the impassability of roads, was experienced more in the AE sectors than in the COE sectors.

(d) There is an apparently unfavorable cost/benefit ratio which developed due to the emphasis placed on "cost engineering". FDAA policy eliminated the reporting of any damage which was determined to be less than $100. The preparation cost/DSR, however, was greater than that figure (COE = $164.37, AE = $190.98). An increase in the cutoff value for DSR's submitted should therefore be considered. An alternate system could be established to reimburse applicants for damage under this cutoff value. A possible solution is the consolidation of small dollar value, damaged areas in order to avoid the costly developing and processing of numerous DSR's.

(e) The AE preparation cost/DSR, 16% higher than that for Corps personnel, is considered significant, but justifiable. A managerial decision was needed and made when insufficient numbers of Corps' personnel were readily available for deployment on this assignment. AE augmentation became a realistic personnel resource since reaction time and speed of mission accomplishment were critical.

V. FISCAL TABULATIONS.

The fiscal responsibilities carried by the New England Division spanned an eight month period. Expenditures for windshield estimates, damage survey report preparation and disaster office administration in the first three months constituted the bulk of NED's disaster costs. The remaining five months included expenditures for specific "callback", additional damage surveys and final inspections. Partial final billing for the period 1 July 1973 thru 28 February 1974 is presented below.

		VERMONT	NEW HAMPSHIRE
FDAA Contract No.		FDAA-397-DR	FDAA-399-DR
Disaster Declared		6 July 1973	11 July 1973
Payment to New York Dist.			
Labor	$44,228.50		
Travel	21,347.49		
Misc.	2.20		
Overhead	12,591.01	$78,169.20	
New England Division Costs			
Labor (Regular)		$49,927.28	$23,283.65
(Overtime)		4,938.21	4,904.87
Travel & Transportation		22,078.82	5,789.29
Div. Revolving Fund O.H.		19,240.00	8,465.00
Material & Supplies		1,907.22	718.61
Contract Costs			
71-C-0078	$ 3,610.50		
74-C-0002	111,657.00		
74-C-0003	14,202.00	$129,469.50	
74-C-0005	$ 23,600.00		
74-C-0006	13,895.00		$37,495.00
TOTAL COST		$305,730.23	$80,656.42

VI. OBSERVATIONS/LESSONS LEARNED.

A. RESERVOIRS/LOCAL PROTECTION PROJECTS.

The flood disaster occurred during the height of the growing season. It deposited a silt film on all vegetation inundated within the reservoir areas. Some tree kill was observed, and NED commissioned CRREL (U.S. Army, Cold Regions Research and Engineering Laboratory) to investigate the phenomenon and submit their findings to NED by September 1974.

Recreational facilities (comfort stations, picnic tables, etc.) within the inundated reservoirs were literally covered with heavy silt deposits and were closed to the public for most of the summer season while cleanup ensued. NED evaluated the damage and decided that no significant relocation of facilities would be made since relocation further from the actual recreation pool water lines would reduce usage and defeat the primary purpose of the facilities.

Estimated damages prevented by Corps reservoirs and local protection projects were made; however, a serious deficiency (lack of updated economic information for many Corps projects) made it impossible to derive accurate benefit figures.

B. EMERGENCY OPERATIONS.

During the period immediately following adverse weather, helicopter support from First Army provided needed mobility for the Division Engineer and also allowed timely inspection of water-control related, SAFETY hazards by COE personnel.

NED's Automatic Hydrologic Radio Reporting Network (AHRRN) coupled with timely input from COE project managers gave satisfactory early flood warning for internal COE use. This resulted in effective water regulation on Corps controlled tributaries and the mainstems of the Connecticut and Merrimack Rivers. NED did not however receive any state or local resident requests for flood fighting assistance along Vermont and New Hampshire uncontrolled tributaries, where most of the damage actually occurred.

The single mission, special team concept, which resulted in the activation of a dam SAFETY inspection team, was highly successful. The team consisting of a structural/civil engineer, a soils engineer, and a hydrologic engineer conducted priority SAFETY evaluations of damaged water impounding facilities. These evaluations provided timely SAFETY information for Vermont and New Hampshire Water Resource Boards and local residents.

C. PL 91-606.

A COE Civil Works boundary split the State of Vermont. Coordination with North Atlantic Division and New York District resulted in NED being the Corps single point of contact with the State and the FDAA. The concept proved to be highly successful. The New York District sent its personnel TDY to NED. The teams arrived without adequate organic transportation and supplies, but adjustments were made and the teams provided satisfactory damage survey coverage within their Civil Works boundary.

The hardest hit damaged areas needed a COE Area Coordinator for every 3-4 DSR teams. He acted as an intermediary between the teams and the COE State Coordinating Office and saved many team administrative man-hours.

Daily coordination between Area Coordinators/DSR teams and the COE State Coordinating Office was found to be essential in order to update team progress and plan future DSR activities.

The time allotted the local applicants in Vermont and New Hampshire to be briefed on, absorb information about, and react to PL 91-606's applicant requirements was less than 2-3 days in some cases. For those applicants not previously familiar with the public law, the time element proved to be insufficient. COE initial damage inspection progress with these applicants was slow.

D. PL 84-99.

In Weston, Vermont, the initial Corps personnel that inspected damage to the local protection project in that town unknowingly gave erroneous information to the local residents concerning the Corp's authorized rehabilitation authority. Though not serious, misunderstandings did ensue and did hinder the Corp's capability for timely response. NED noted that new COE and AE DSR team personnel needed initial instruction, and seasoned Corps personnel needed refresher instruction, in identifying and reacting to PL 84-99 damage and rehabilitation considerations.

E. ARCHITECT-ENGINEER AUGMENTATION.

The utilization of Architect-Engineer personnel in COE disaster field organizations was highly successful. An initial day of classroom instruction coupled with initial close supervision in the field produced knowledgeable teams and a satisfactory product, i.e. damage survey reports.

Architect-Engineer personnel vs. COE personnel productivity and costs were analyzed. Productivity (DSR's prepared/team day) was essentially equal. AE preparation cost/DSR, 16% higher than that for Corps personnel, was considered significant, but justifiable. A managerial decision was made when insufficient numbers of Corps personnel were readily available for deployment on this assignment. AE augmentation became a realistic personnel resource since reaction time and speed of mission accomplishment were critical. Given similar constraints on COE personnel availability, NED would consider utilizing AE support in the future.